

Third International Conference

**Clean Coal Technologies
for our Future
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**Cost of Electricity Challenges for Fossil fired Power Plants
Today and Tomorrow**

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Content

- **Frame Conditions**

- Coal Price Development
- Gas Price Development
- CO₂ Price Development

- **Power Plant Data in 2005, 2030, 2050**

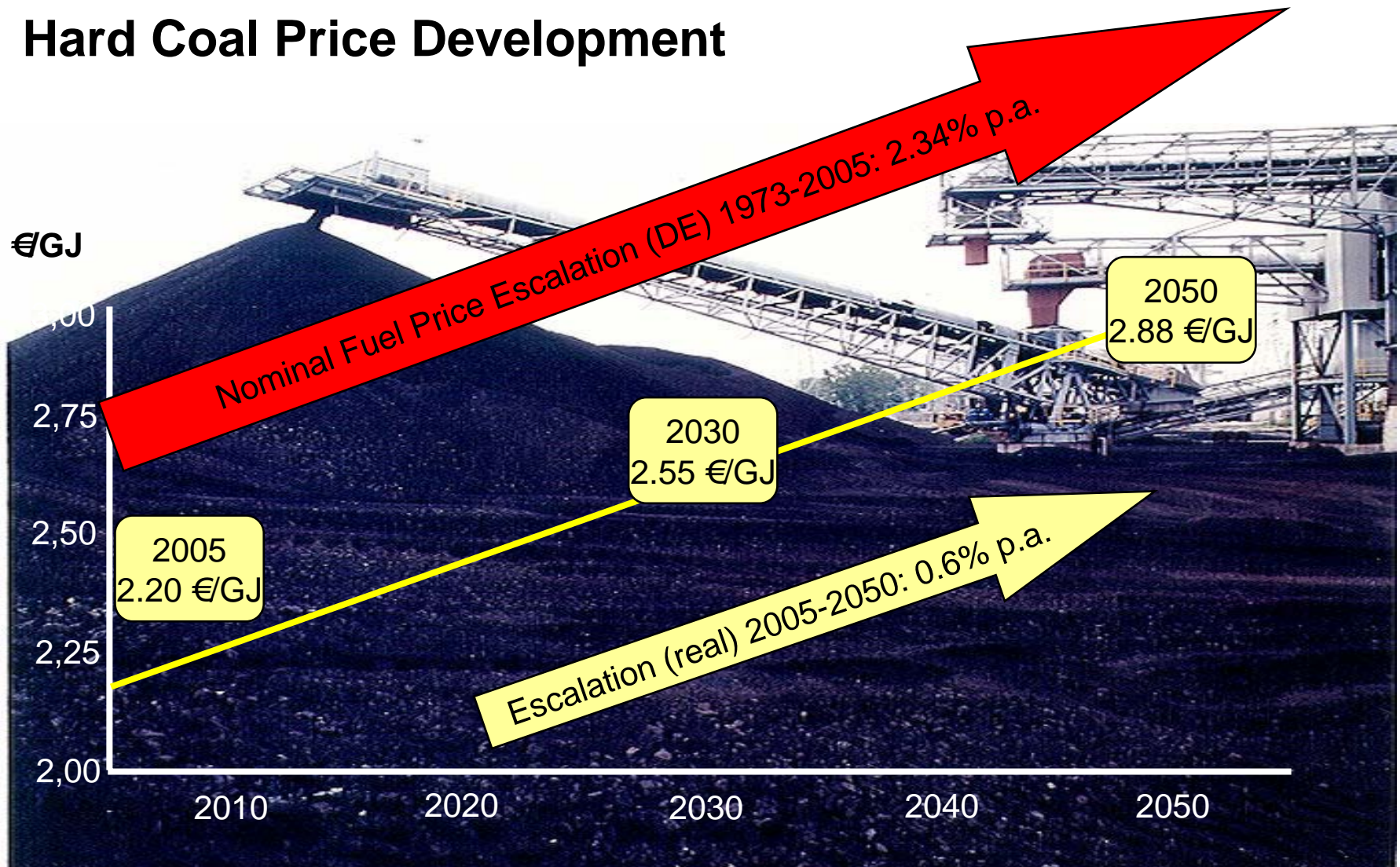
- PC Power Plant (Hard Coal and Lignite)
- NGCC Power Plant
- IGCC Power Plant
- Oxyfuel Power Plant

- **Anticipated CoE in 2005, 2030, 2050**

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- NGCC Power Plant
- IGCC Power Plant
- Oxyfuel Power Plant

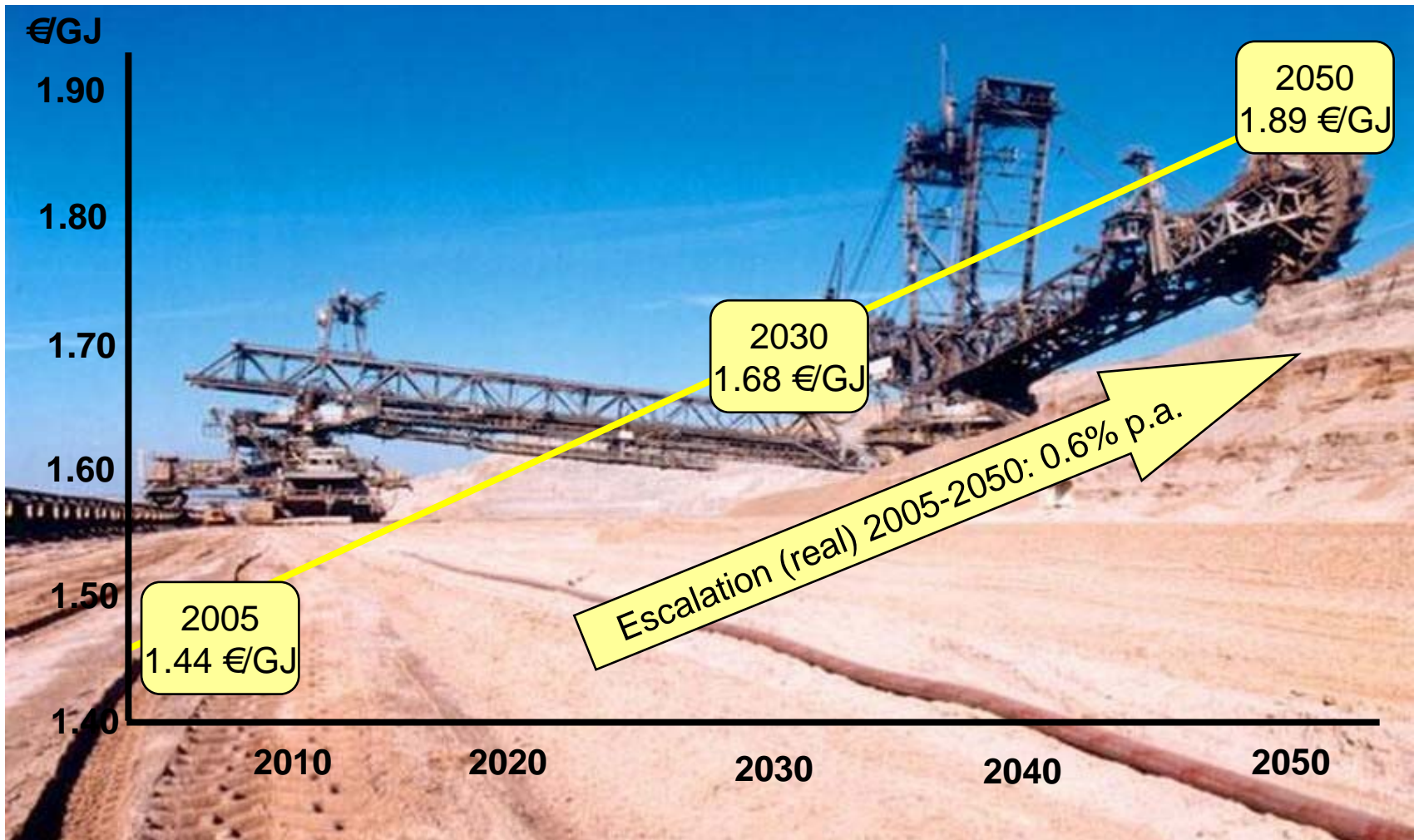
- **CoE Scenarios**

Hard Coal Price Development

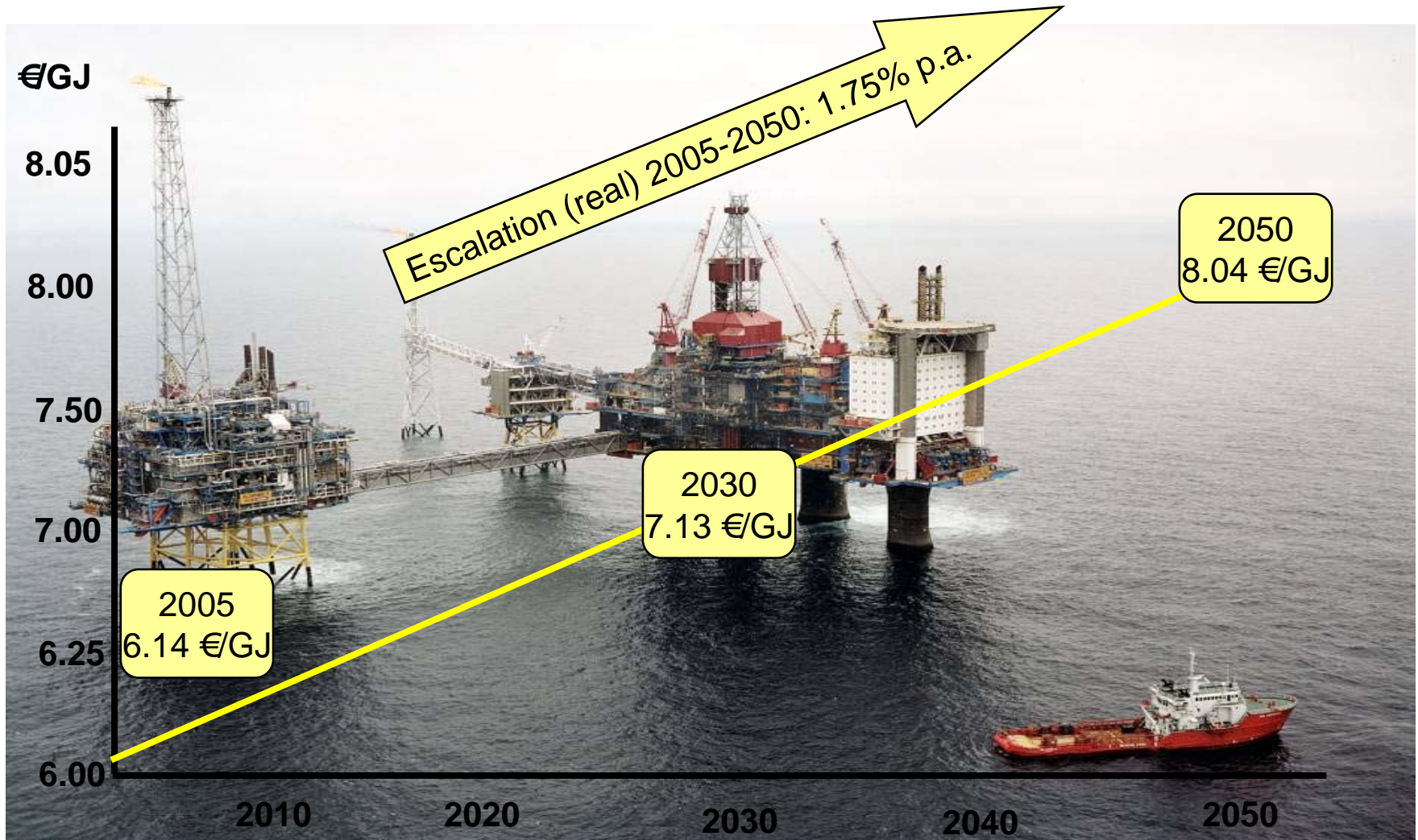


Hu: 25,000 kJ/kg

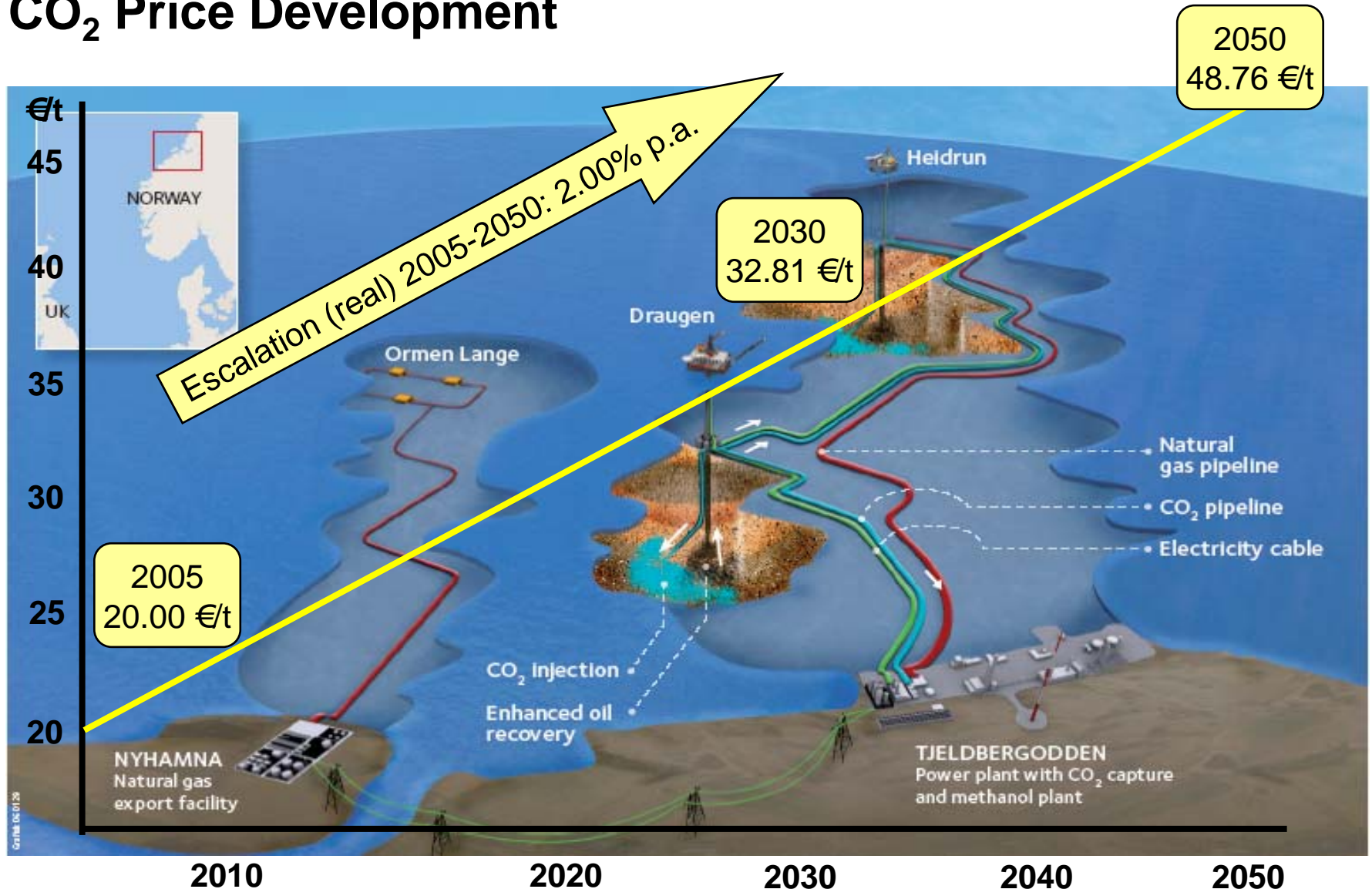
Lignite Price Development



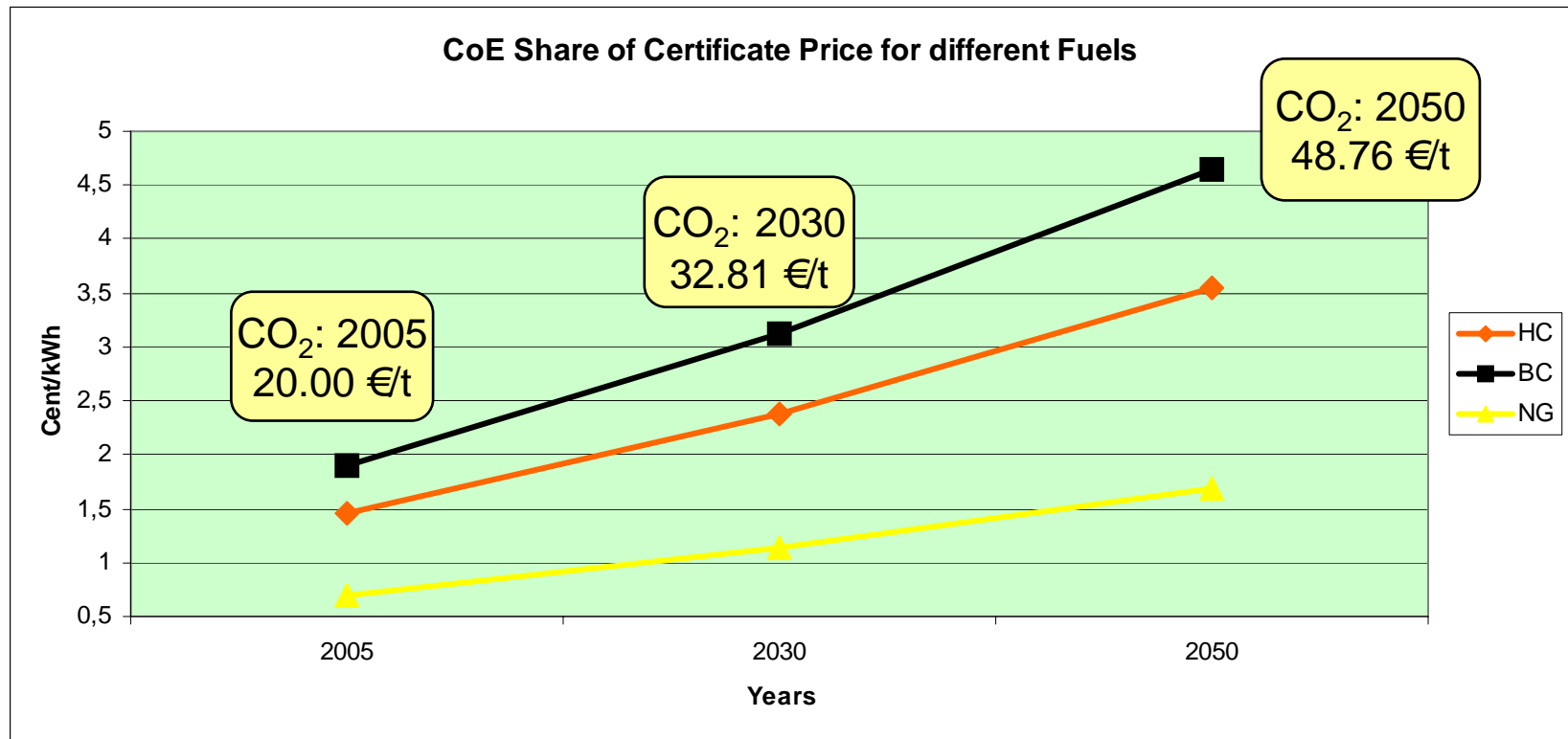
Natural Gas Price Development



CO₂ Price Development



CoE Price Increase due to CO₂ Escalation only Hard Coal/Lignite/Gas *)



*)2005 Technology w/o CCC; 800 MW: Efficiency PC-HC=46%, PC-Lignite=43%, NGCC=58%
CO₂ Coefficient: Hard Coal: 93 t CO₂/TJ; Lignite (BC): 114 t CO₂/TJ; Natural Gas: 56 t CO₂/TJ

Basic Data Hard Coal fired Power Plant

		2005	2030	2030 CC	2050 CC
Parameters		PCC Hard Coal			
Operating hours	h p.a.	7.500	7.500	7.500	7.500
Pe gross	MW	1.100	1.100	1.012	1.012
Efficiency gross	%	49,9	55,8	56,3	58,0
Pe auxiliary	MW	85	75	319	265
Efficiency net	%	46,0	52,0	40,0	44,0
Pe net	MW	1.015	1.025	721	769
EPC Price	Mio €	964	1.005	1.328	1.336
Owners Costs	Mio €	120	120	140	140
Total Costs	Mio €	1.084	1.125	1.468	1.476
Total spec. Costs	€/kWn	1.068	1.097	2.036	1.919

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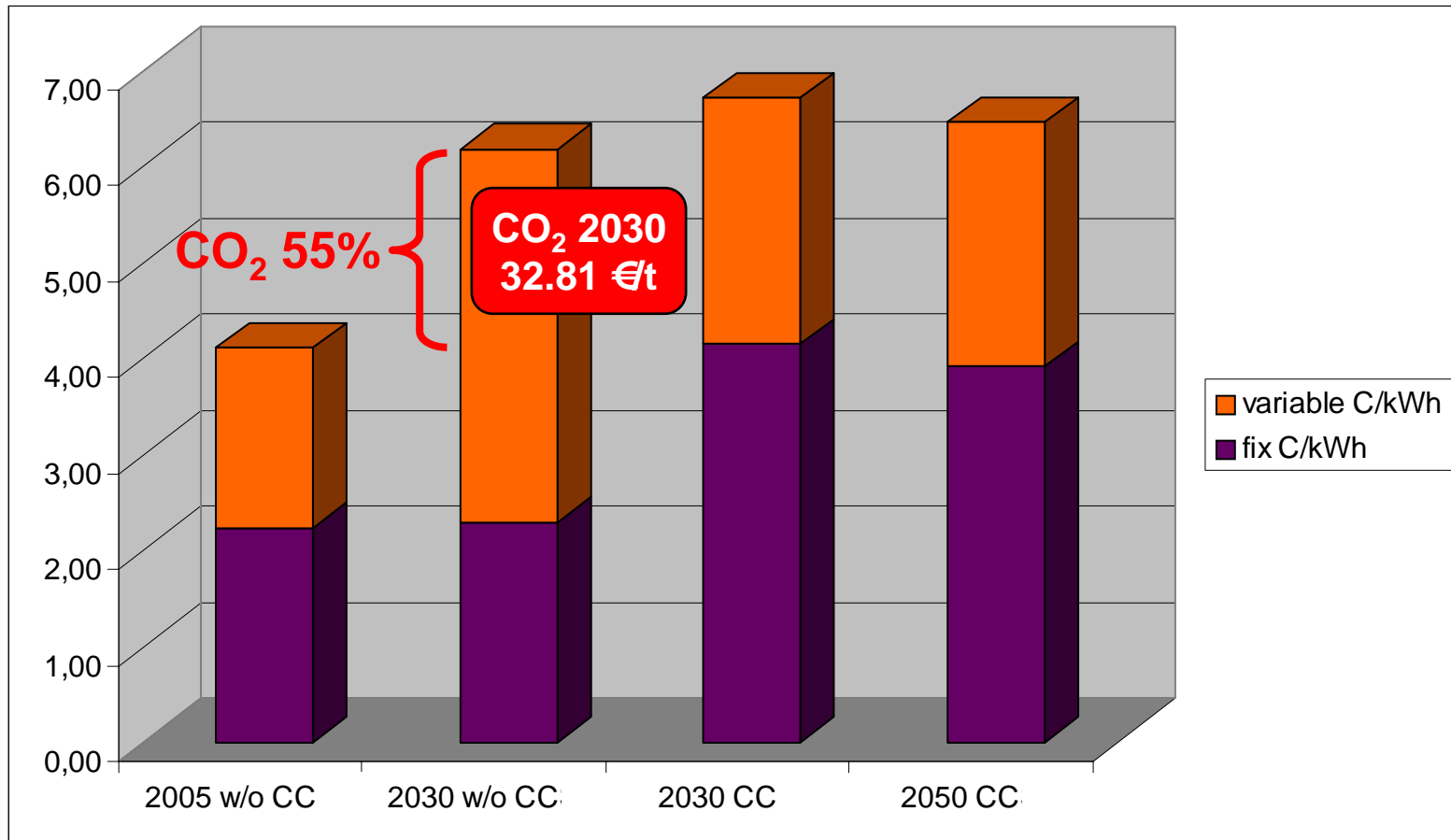
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Parameters		PCC Hard Coal			
Operating hours	h p.a.	7.500	7.500	7.500	7.500
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Efficiency gross	%	49,9	55,8	56,3	58,0
Pe auxiliary	MW	85	75	319	265
Efficiency net	%	46,0	52,0	40,0	44,0
Pe net	MW	1.015	1.025	721	769
EPC Price	Mio €	964	1.005	1.328	1.336
Owners Costs	Mio €	120	120	140	140
Total Costs	Mio €	1.084	1.125	1.468	1.476
Total spec. Costs	€/kWn	1.068	1.097	2.036	1.919

CoE Hard Coal fired Power Plant



Basic Data Lignite fired Power Plant

		2005	2030	2030 CC	2050 CC
Parameters		PCC Lignite			
Operating hours	h p.a.	7.500	7.500	7.500	7.500
Pe gross	MW	1.000	1.000	920	920
Efficiency gross	%	45,8	58,2	51,8	53,6
Pe auxiliary	MW	50	80	130	130
Efficiency net	%	43,5	53,5	44,5	46,0
Pe net	MW	950	920	790	790
EPC Price	Mio €	969	1.127	1.604	1.580
Owners Costs	Mio €	110	125	170	170
Total Costs	Mio €	1.079	1.252	1.774	1.750
Total spec. Costs	€/kWn	1.136	1.361	2.245	2.215

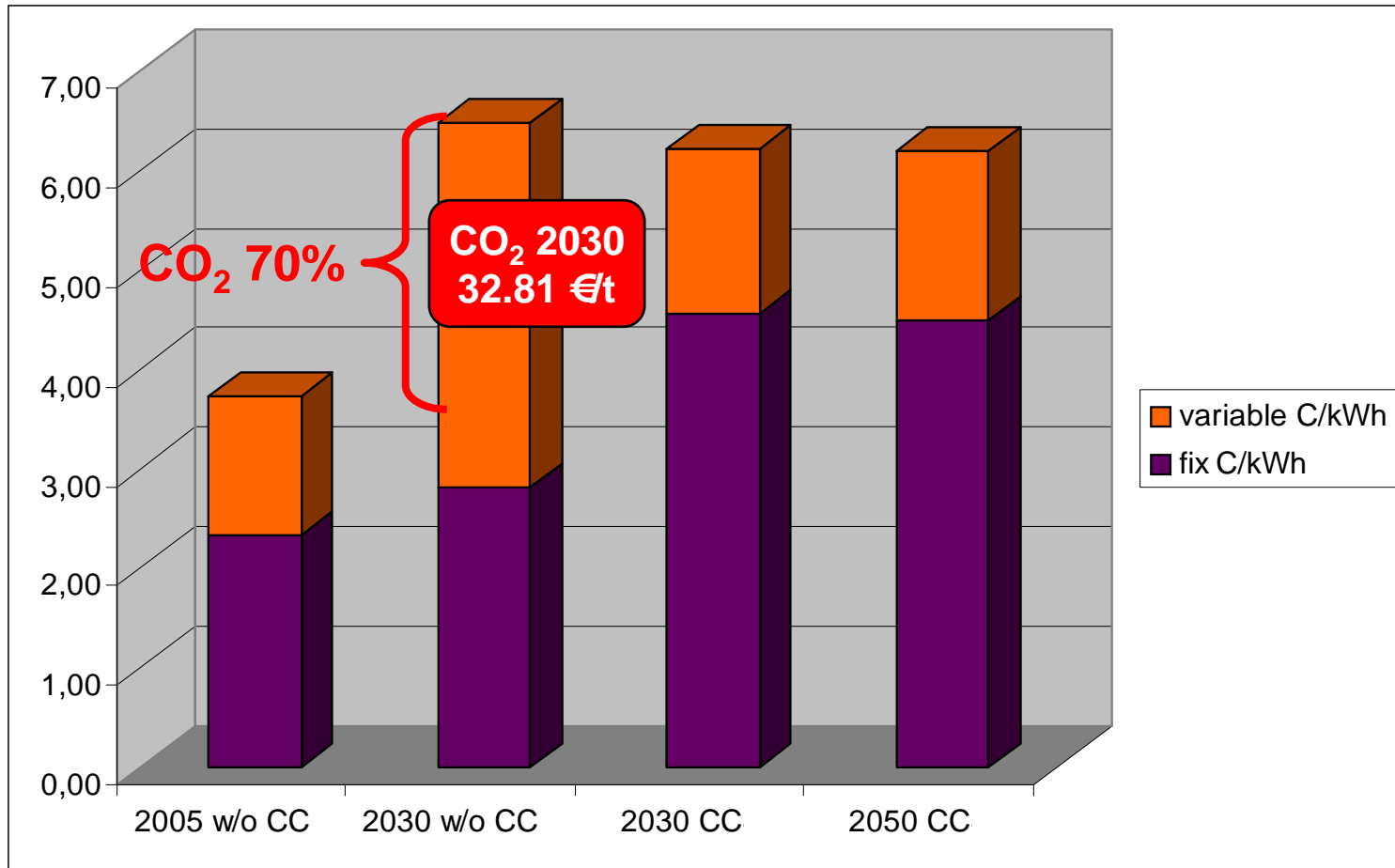
Basic Data Lignite fired Power Plant

		2005	2030	2030 CC	2050 CC
Parameters		PCC Lignite			
Operating hours	h p.a.	7.500	7.500	7.500	7.500
Pe gross	MW	1.000	1.000	920	920
Efficiency gross	%	45,8	58,2	51,8	53,6
Pe auxiliary	MW	50	80	130	130
Efficiency net	%	43,5	53,5	44,5	46,0
Pe net	MW	950	920	790	790
EPC Price	Mio €	969	1.127	1.604	1.580
Owners Costs	Mio €	110	125	170	170
Total Costs	Mio €	1.079	1.252	1.774	1.750
Total spec. Costs	€/kWn	1.136	1.361	2.245	2.215

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		2005	2030	2030 CC	2050 CC
Parameters		PCC Lignite			
Operating hours	h p.a.	7.500	7.500	7.500	7.500
Pe gross	MW	1.000	1.000	920	920
Efficiency gross	%	45,8	58,2	51,8	53,6
Pe auxiliary	MW	50	80	130	130
Efficiency net	%	43,5	53,5	44,5	46,0
Pe net	MW	950	920	790	790
EPC Price	Mio €	969	1.127	1.604	1.580
Owners Costs	Mio €	110	125	170	170
Total Costs	Mio €	1.079	1.252	1.774	1.750
Total spec. Costs	€/kWn	1.136	1.361	2.245	2.215

CoE Lignite fired Power Plant



Basic Data Natural Gas fired Power Plant

		2005	2030	2030 CC	2050 CC
Parameters		NGCC			
Operating hours	h p.a.	6.000	6.000	6.000	6.000
Pe gross	MW	800	800	800	800
Efficiency gross	%	59,0	63,0	63,0	66,0
Pe auxiliary	MW	16	16	81	81
Efficiency net	%	57,8	61,7	56,6	59,3
Pe net	MW	784	784	719	719
EPC Price	Mio €	321	354	486	486
Owners Costs	Mio €	26	28	39	39
Total Costs	Mio €	347	382	525	525
Total spec. Costs	€/kWn	443	487	731	731

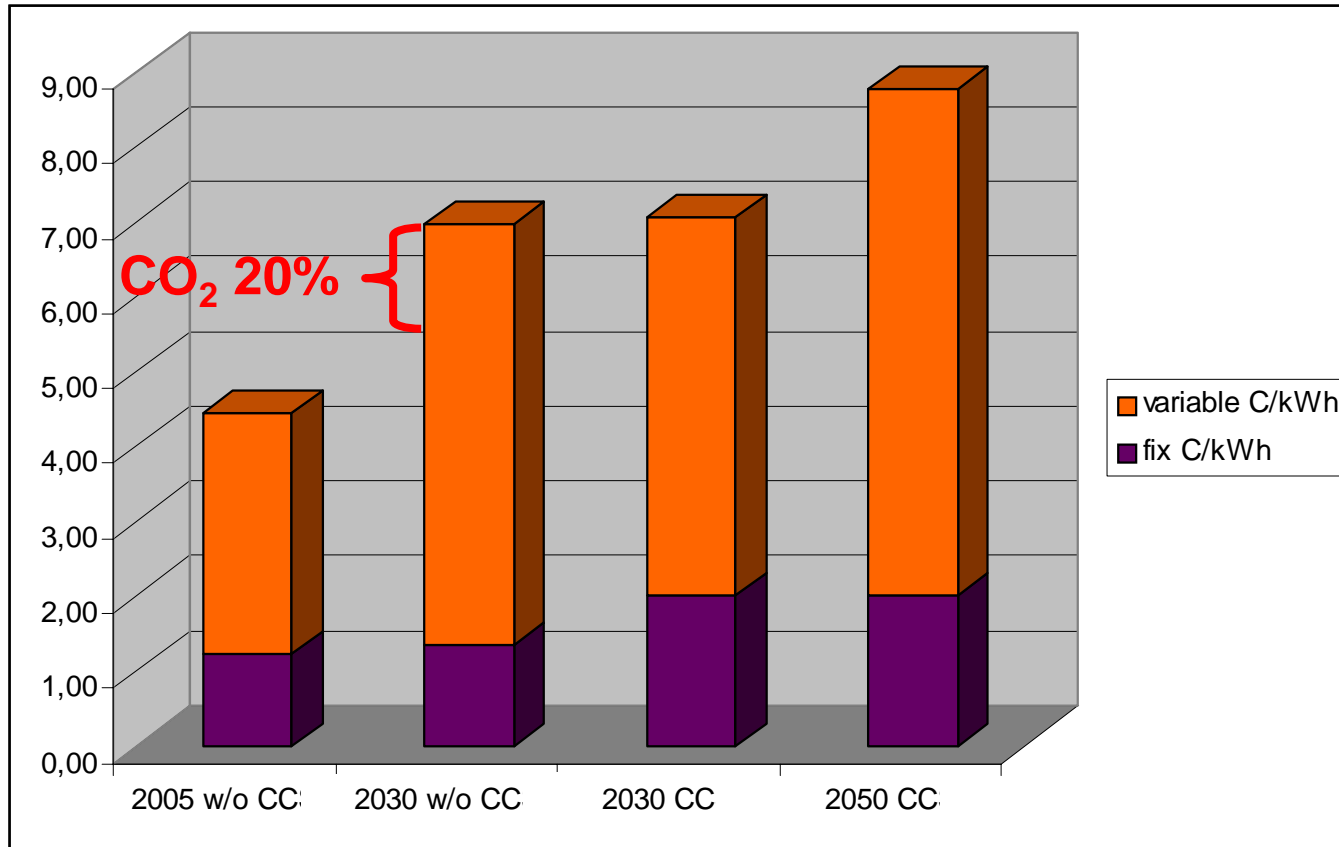
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		2005	2030	2030 CC	2050 CC
Parameters		NGCC			
Operating hours	h p.a.	6.000	6.000	6.000	6.000
Pe gross	MW	800	800	800	800
Efficiency gross	%	59,0	63,0	63,0	66,0
Pe auxiliary	MW	16	16	81	81
Efficiency net	%	57,8	61,7	56,6	59,3
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		2005	2030	2030 CC ⁻	2050 CC ⁻
Parameters		NGCC			
Operating hours	h p.a.	6.000	6.000	6.000	6.000
Pe gross	MW	800	800	800	800
Efficiency gross	%	59,0	63,0	63,0	66,0
Pe auxiliary	MW	16	16	81	81
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EPC Price	Mio €	321	354	486	486
Owners Costs	Mio €	26	28	39	39
Total Costs	Mio €	347	382	525	525
Total spec. Costs	€/kWn	443	487	731	731

CoE NG Combined Cycle Power Plant



Basic Data IGCC

		2005	2030	2030 CS	2050 CS
Parameters		IGCC HC			
Operating hours	h p.a.	7.000	7.000	7.000	7.000
Pe gross	MW	968	1.100	1.088	1.181
Efficiency gross	%	52,1	57,9	53,2	57,7
Pe auxiliary	MW	112	112	208	198
Efficiency net	%	46,1	52,0	43,0	48,0
Pe net	MW	856	988	880	983
EPC Price	Mio €	1.023	1.077	1.214	1.268
Owners Costs	Mio €	153	153	174	174
Total Costs	Mio €	1.176	1.230	1.388	1.442
Total spec. Costs	€/kWn	1.373	1.245	1.578	1.467

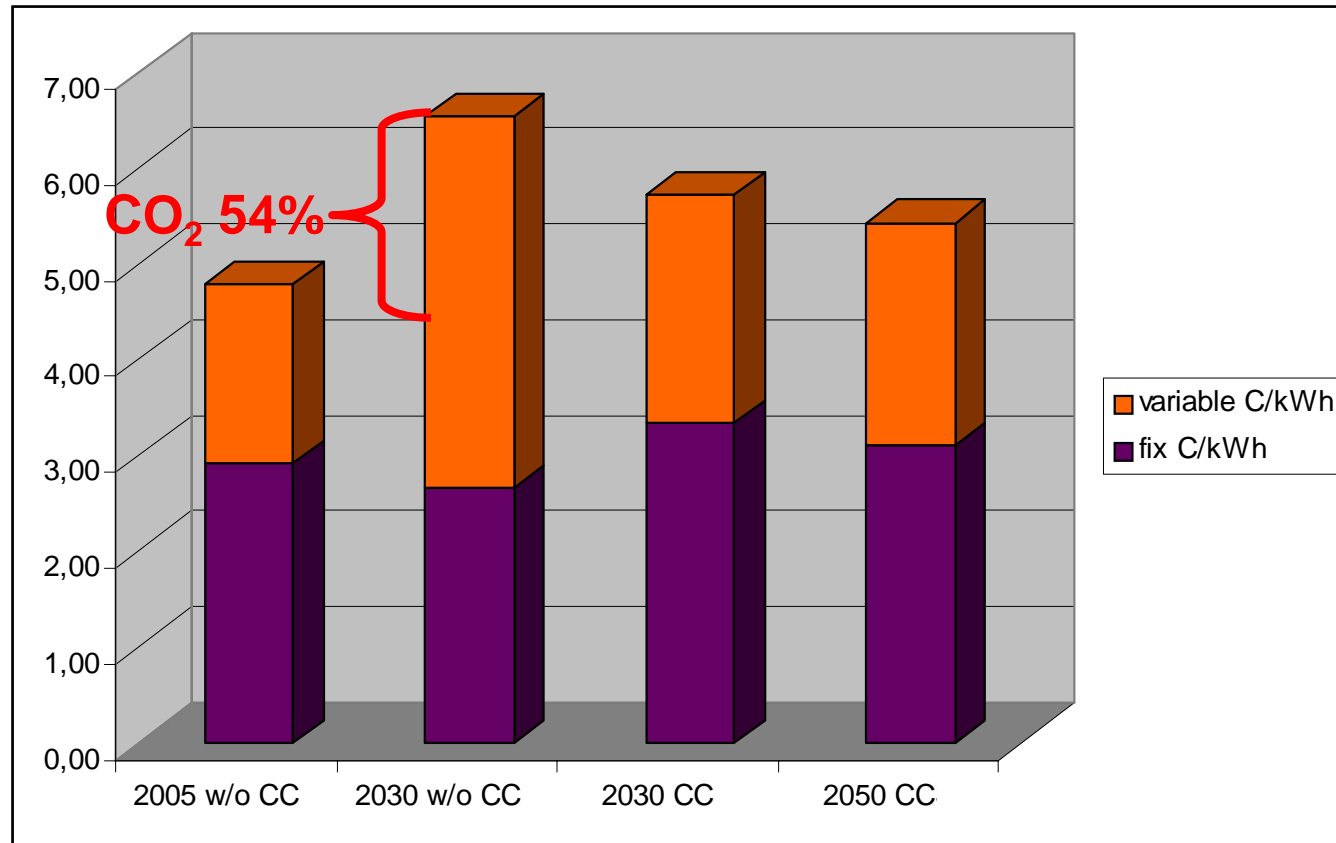
Basic Data IGCC

		2005	2030	2030 CCS	2050 CCS
Parameters		IGCC HC			
Operating hours	h p.a.	7.000	7.000	7.000	7.000
Pe gross	MW	968	1.100	1.088	1.181
Efficiency gross	%	52,1	57,9	53,2	57,7
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CoE IGCC



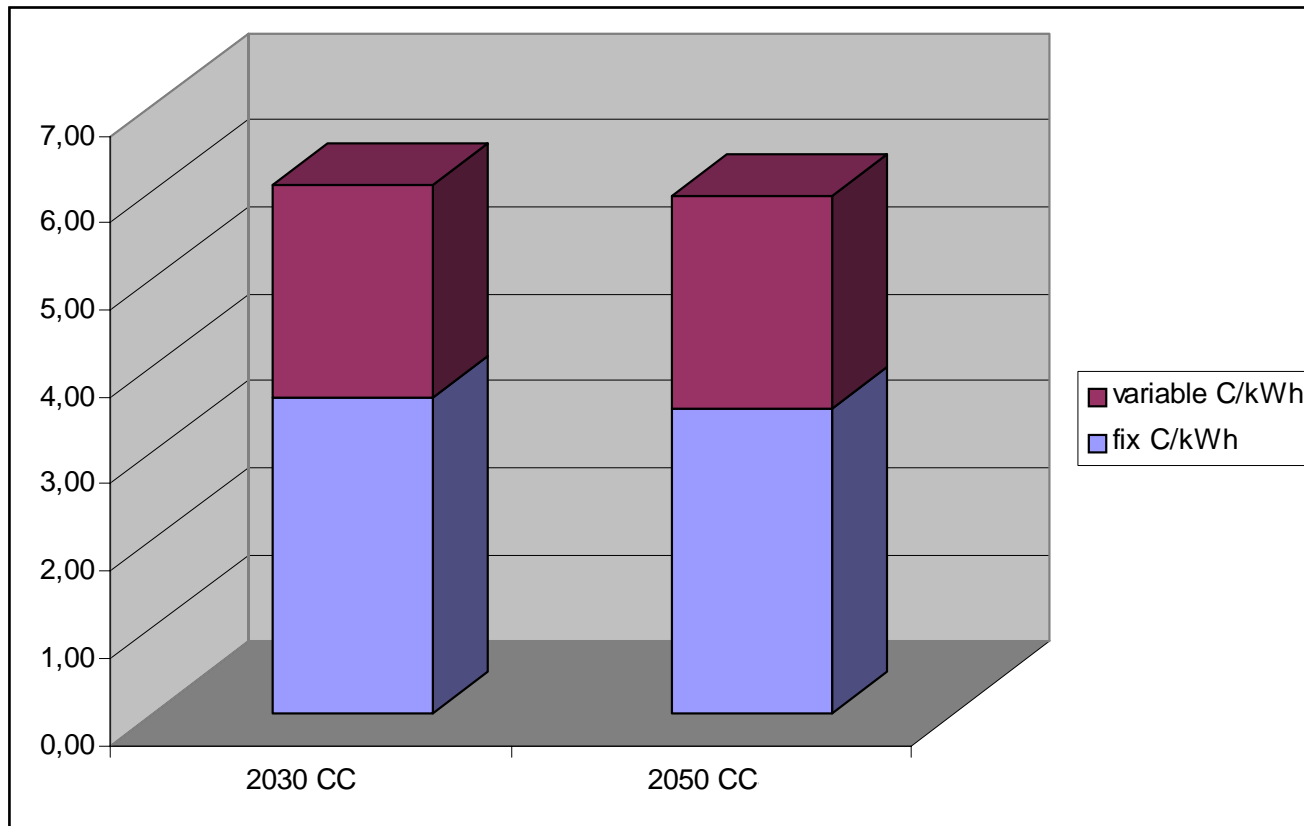
Basic Data Oxyfuel

		2030 - CS	2050 - CS
Parameters		OXYFUEL HC	
Operating hours	h p.a.	7.000	7.000
Pe gross	MW	1.100	1.100
Efficiency gross	%	52,1	55,5
Pe auxiliary	MW	214	188
Efficiency net	%	42,0	46,0
Pe net	MW	886	912
EPC Price	Mio €	1.329	1.322
Owners Costs	Mio €	140	140
Total Costs	Mio €	1.469	1.463
Total spec. Costs	€/kW n	1.658	1.604

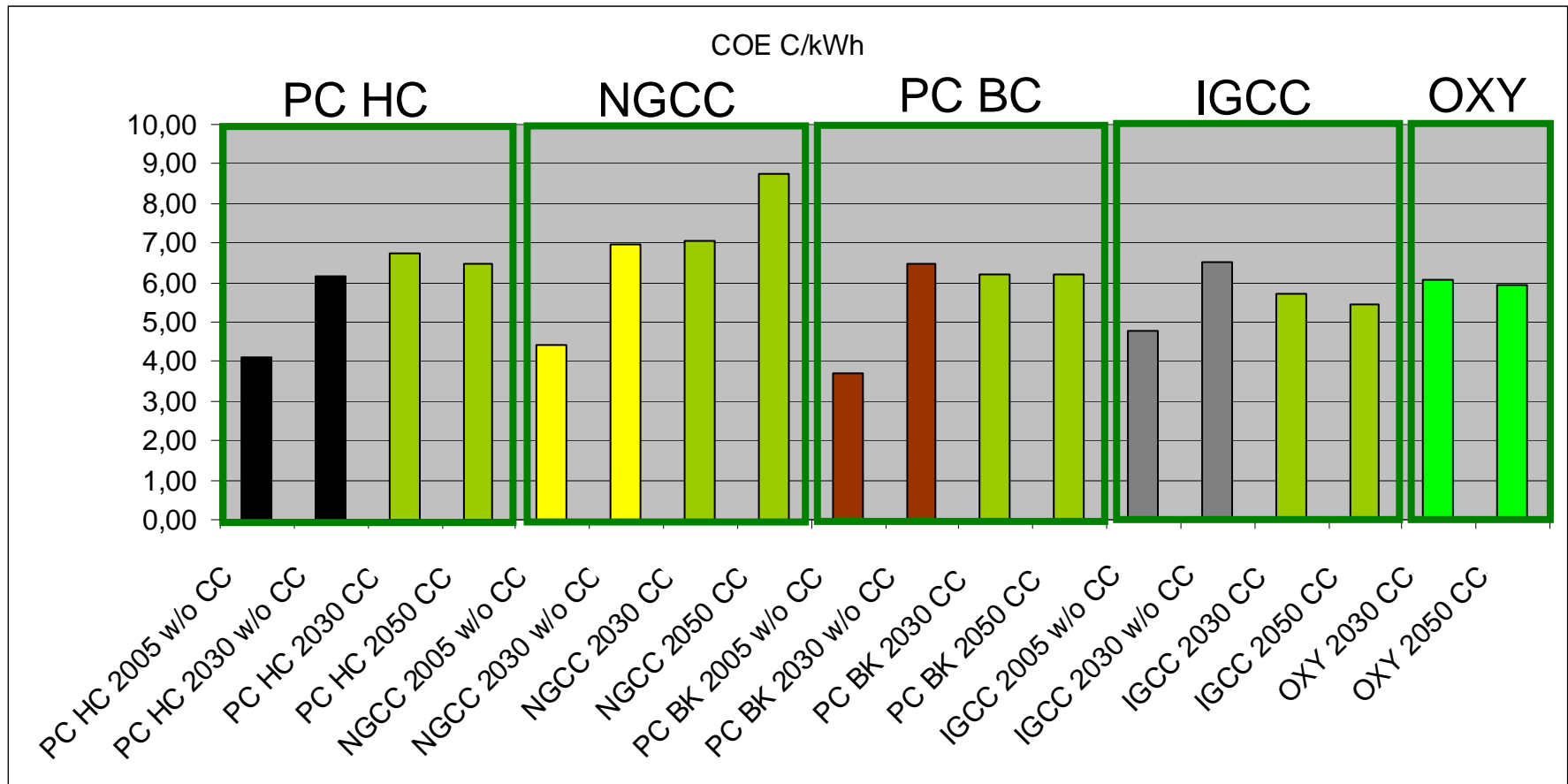
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		2030 - CS	2050 - CS
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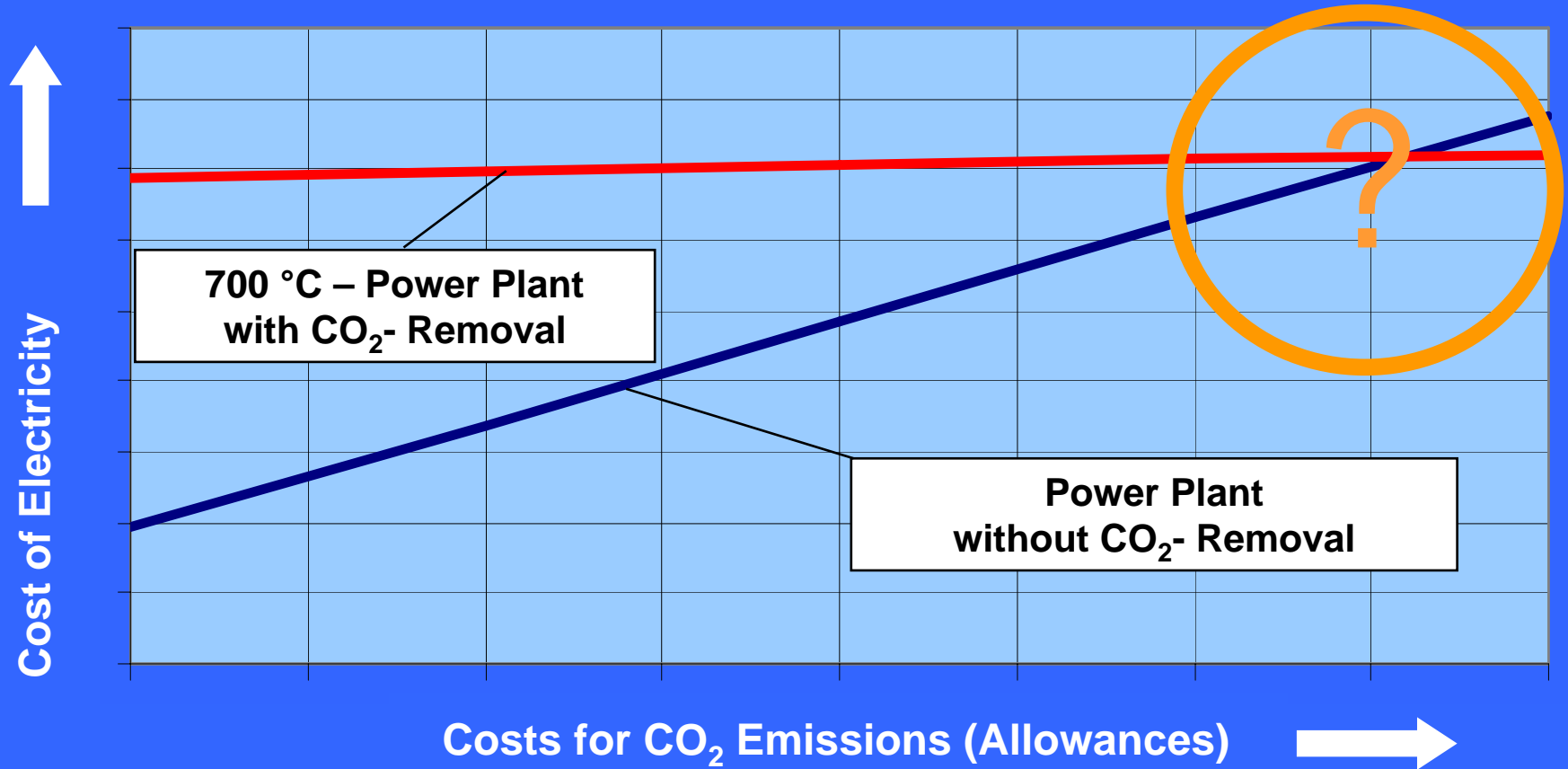
CoE Oxyfuel



Summary CoE of different Technologies



Challenges for CO₂-free Power Plant



VGB



POWERTECH

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